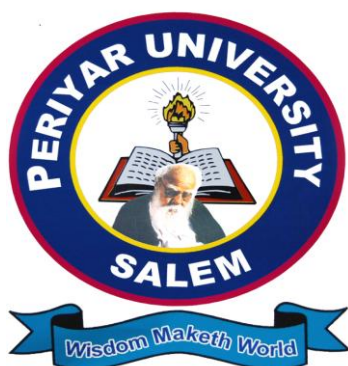


PERIYAR UNIVERSITY
PERIYAR PALKALAI NAGAR
SALEM – 636 011



DEGREE OF BACHELOR OF
SCIENCE
CHOICE BASED CREDIT SYSTEM

SYLLABUS FOR B.Sc. BIOTECHNOLOGY

FOR THE STUDENTS ADMITTED FROM THE
ACADEMIC YEAR 2012 – 2013 ONWARDS

REGULATIONS

1. Objectives of the course:

- To learn the applications of biological agents to provide goods and services for human community by materials processing.
- To equip the practical skills of molecular and genome based techniques.
- To gain knowledge on frontier areas of Biotechnology.
- To understand the impact of Biotechnology on basic human needs such as Agriculture, Industry, Medicine, Environment etc.
- To enrich the knowledge of students on current scenario in Biotechnology

2. Eligibility for Admission:

Candidates seeking admission to the first year Degree course shall be required to have passed PUC/12th Std. / 10+2/ its equivalent with at least Biology and Chemistry as two optional subjects.

3. Duration of the course:

The duration of the course is THREE academic years divided into six semesters under Choice Based Credit System.

4. Features of CBCS:

Under Choice Based Credit System (CBCS), a set of papers consisting of Core papers, Elective papers, Skill based elective papers and Non-major elective papers are offered. Beside the Core Papers, which are totally related to the major subject, the students have the advantage of studying supportive papers and non-major papers. This provides enough opportunity to the students to learn not only the major subject but also inter disciplinary and application oriented subjects.

5. Credits:

In CBCS, each paper is assigned with a certain number of Credits depending upon the workload of the students. The total Credits to be earned by a student to qualify for the degree is 140. The credit of the paper is fixed by giving due weightage to the syllabus content and contact hours per week.

6. Evaluation Procedure:

Evaluation is based on Continuous Internal Assessment (**CIA**) test and University Examination. Distribution of marks as follows

THEORY

| | |
|-----------------------------|--------------------------|
| University examination (UE) | Internal Assessment (IA) |
| 75 marks | 25 marks |

PRACTICAL

| | |
|-----------------------------|--------------------------|
| University examination (UE) | Internal Assessment (IA) |
| 60 marks | 40 marks |

7. Question Paper Pattern

THEORY

Time: 3 Hours

Max. Marks: 75

SECTION – A

Answer ALL Questions:

(10 x 2= 20marks)

All Question Carry equal marks-2 questions from each unit

SECTION – B

Answer ALL Questions:

(5x 5 = 25marks)

(Internal Choice)

All Questions carry equal marks-2 questions from each unit.

SECTION – C

Answer any THREE out of five
30marks)

(3 x 10 =

1 question from each unit

All units in the syllabus should be given equal weightage

PRACTICAL

Time: 6 Hours

Maximum Marks: 60

Major Practical

20 Marks

Minor Practical

10 Marks

Spotters

5 x 4 = 20 Marks

Record

5 Marks

Viva-voce

5 Marks

8. Model Question paper:

NOVEMBER/DECEMBER 2012

Fifth Semester

Biotechnology

MOLECULAR BIOLOGY

Time: Three hours
marks

Maximum: 75

SECTION A – (10 X 2 = 20 marks)

Answer ALL questions

1. SSBP
2. Okazaki fragments
3. Gene silencing
4. Poly adenylation
5. Oncogenes
6. Post translational modification
7. Tumour suppressor genes
8. Recombination

9. Hybridization

10. Genome mapping

SECTION B (5 X 5= 25 marks)

Answer ALL questions

11. (a) Trace the mechanism of DNA replication.

Or

(b) Explain briefly the DNA repair mechanism.

12. (a) Write short note on RNA splicing.

Or

(b) Describe the exportation of mRNA from nucleus.

13. (a) How are proteins imported into mitochondria?

Or

(b) Explain about the gene silencing.

14. (a) Give an account on cancer.

Or

(b) Write short notes on Tumour suppressor genes.

15. (a) Explain about the genetic mapping.

(b) Describe about the physical mapping.

SECTION C - (3 X 10= 30 marks)

Answer any THREE questions

16. Discuss the regulation of gene expression with reference to trp operon.

17. Explain in detail the modifications in RNA in the process of transcription.

18. Analyse the events in translation process.

19. Describe the Holliday model of genetic recombination.

20. Write a detailed account on southern in situ hybridization.

BSc., Biotechnology – Course Structure (CBCS Pattern- 2012-2013 Onwards)

| Part | Sem | Paper Code | Title of the Paper | Lecture Hrs/Week | Credits | Int. Marks | Ext. Marks |
|--|------------|--------------------------------------|---|------------------|---------|------------|------------|
| Part – I | I | 12UFTA01 / 12UFMA01 / 12UFHI01 | Tamil – I / Malayalam – I / Hindi – I | 6 | 3 | 25 | 75 |
| Part – II | | 12UFEN01 | English – I | 6 | 3 | 25 | 75 |
| Part - III - Core - I | | 12UBT01 | Cell Biology | 6 | 5 | 25 | 75 |
| Part - III - Allied – I | | 12UBCA01 | Biochemistry - I | 5 | 4 | 25 | 75 |
| Part - IV - Value Education | | 12UVE01 | Manavalakkalai Yoga | 1 | 2 | 25 | 75 |
| Part – I | II | 12UFTA02 / 12UFMA02 / 12UFHI02 | Tamil – II / Malayalam – II / Hindi – II | 6 | 3 | 25 | 75 |
| Part – II | | 12UFEN02 | English – II | 6 | 3 | 25 | 75 |
| Part – III - Core - II | | 12UBT02 | Genetics | 5 | 5 | 25 | 75 |
| Part - III - Allied – II | | 12UBCA02 | Biochemistry – II | 4 | 3 | 25 | 75 |
| Part - IV - SBEC – I | | 12UBTS01 | Taxonomy and Biodiversity | 2 | 2 | 25 | 75 |
| Part - III - Core Practical - I | | 12UBTP01 | Lab in Cell Biology and Genetics | 3+3=6 | 3 | 40 | 60 |
| Part - III - Allied Practical | | 12UBCAP01 | Allied Practical - I - Biochemistry | 3+3=6 | 3 | 40 | 60 |
| Part - IV | | 12UES01 | Environmental Studies | 1 | 2 | 25 | 75 |
| Part – I | III | 12UFTA03 / 12UFMA03 / 12UFHI03 | Tamil – III / Malayalam – III / Hindi – III | 6 | 3 | 25 | 75 |
| Part – II | | 12UFEN03 | English – III | 6 | 3 | 25 | 75 |
| Part - III - Core - III | | 12UBT03 | Fundamentals of Microbiology | 4 | 5 | 25 | 75 |
| Part - III - Allied – III | | 12USTA06 | Biostatistics | 4 | 3 | 25 | 75 |
| Part - IV - SBEC – II | | 12UBTS02 | Developmental Biology | 2 | 2 | 25 | 75 |
| Part - IV | | 12UBTN01 | Concepts of | 2 | 2 | 25 | 75 |

| NMEC – I | | | Biotechnology | | | | |
|----------------------------------|-----------|--------------------------------|--|-------|---|----|----|
| Part – I | IV | 12UFTA04 / 08UFMA04 / 08UFHI04 | Tamil – IV / Malayalam – IV / Hindi – IV | 6 | 3 | 25 | 75 |
| Part – II | | 12UFEN04 | English – IV | 6 | 3 | 25 | 75 |
| Part - III - Core - IV | | 12UBT04 | Biophysics and Instrumentation | 5 | 5 | 25 | 75 |
| Part - III Allied – IV | | 12UCSA04 | Computer Applications in Biology | 5 | 4 | 25 | 75 |
| Part - III - Core Practical - II | | 12UBTP02 | Lab in Microbiology and Biophysics | 3+3=6 | 4 | 40 | 60 |
| Part - III - Allied Practical | | 12UCSAP02 | Allied Practical - II - Biostatistics and Computer Applications in Biology | 3+3=6 | 3 | 40 | 60 |
| Part - IV - NMEC – II | | 12UBTN02 | Biotechnology for Society | 2 | 2 | 25 | 75 |
| Part - III - Core - V | V | 12UBT05 | Molecular Biology | 5 | 5 | 25 | 75 |
| Part - III - Core - VI | | 12UBT06 | Plant Biotechnology | 5 | 5 | 25 | 75 |
| Part - III - Core - VII | | 12UBT07 | Recombinant DNA technology | 5 | 5 | 25 | 75 |
| Part - III - Elective - I | | 12UBTE01 | Immunology and Immunotechnology | 5 | 5 | 25 | 75 |
| Part - IV - SBEC – III | | 12UBTS03 | Bioinformatics, Intellectual Property Rights and Biosafety | 2 | 2 | 25 | 75 |
| Part - IV - SBEC – IV | | 12UBTS04 | Food Biotechnology | 2 | 2 | 25 | 75 |
| Part - III - Core - VIII | VI | 12UBT08 | Industrial Biotechnology | 5 | 5 | 25 | 75 |
| Part - III - Core - IX | | 12UBT09 | Animal Biotechnology | 5 | 5 | 25 | 75 |
| Part - III - Elective - II | | 12UBTE02 | Environmental Biotechnology | 5 | 5 | 25 | 75 |
| Part - III - Elective - III | | 12UBTE03 | Plant Molecular Biology | 5 | 5 | 25 | 75 |
| Part - IV - | | 12UBTS05 | Pharmaceutical | 2 | 2 | 25 | 75 |

| | | | | | | | |
|-----------------------------------|----------|---|-------|------------|-------------|-------------|--|
| SBEC – V | | Biotechnology | | | | | |
| Part - IV - SBEC – VI | 12UBTS06 | Nano Biotechnology | 2 | 2 | 25 | 75 | |
| Part - III - Core Practical - III | 12UBTP03 | Lab in Immunology, rDNA technology and Bioinformatics | 3+3=6 | 4 | 40 | 60 | |
| Part - III - Core Practical - IV | 12UBTP04 | Lab in Industrial, Plant and Animal Biotechnology | 3+3=6 | 4 | 40 | 60 | |
| Part - V | 12UEX01 | Extension Activities | - | 1 | - | - | |
| Grand Total | | | | 140 | 1090 | 2910 | |

LIST OF COURSES

CORE COURSE: 13 (Theory 9+ Practical 4)

1. Cell Biology
2. Genetics
3. Fundamentals of Microbiology
4. Biophysics and Instrumentation
5. Molecular Biology
6. Plant Biotechnology
7. Recombinant DNA Technology
8. Industrial Biotechnology
9. Animal Biotechnology

PRACTICAL

1. Lab in Cell biology and Genetics
2. Lab in Microbiology and Biophysics
3. Lab in Immunology, rDNA Technology and Bioinformatics.
4. Lab in Industrial, Plant and Animal Biotechnology

ALLIED COURSE: 6 (Theory 4+practicals 2)

ALLIED COURSE

1. Biochemistry I
2. Biochemistry II
3. Biostatistics
4. Computer Applications in Biology

ALLIED PRACTICAL

1. Lab in Biochemistry
2. Lab in Biostatistics and Computer applications in biology

ELECTIVE COURSE: 3

1. Immunology and Immunotechnology
2. Environmental Biotechnology
3. Plant Molecular Biology

SKILL BASED ELECTIVE COURSE (SBEC): 6

1. Taxonomy and Biodiversity
2. Developmental Biology
3. Bioinformatics, Intellectual Property Rights and Biosafety
4. Food Biotechnology
5. Pharmaceutical Biotechnology
6. Nano Biotechnology

NON MAJOR ELECTIVE (NMEC): 2

NMEC -I Concepts of Biotechnology

NMEC- II Biotechnology for Society

VALUE EDUCATION: 1

ENVIRONMENTAL STUDIES: 1

EXTENSION ACTIVITY

CORE COURSE I

CELL BIOLOGY

UNIT I

Cell as a Basic unit; Classification of cell types; Cell theory; Organization of plant and animals cells; Structural comparison of Microbial, Plant and Animal cells.

UNIT II

Ultra structure of cells; Sub cellular Organization; structure and function of Cell wall, cell membrane, Cytosol Endoplasmic reticulum and Chloroplast, vacuoles, Peroxisomes,lyzosome.

UNIT III

Chromosomes and cell division: Morphology, Structural organization, ultra Structure of chromosome, specialized chromosomes. Cell cycle, Mitosis, Meiosis, Cellular senescence and applications.

UNIT IV

Specialized cells: Motile cells (amoeboid, ciliary, flagellar movements), nerve Cells and nerve impulse conduction, muscle cells and muscle contraction.

UNIT V

Cell-Cell adhesion, Cell signaling- types- G Protein receptors, Cell membrane traffic, Histological techniques- Sectioning, Embedding and Mounting.

REFERENCES:

1. A Text Book of Cell Biology- **Aminul Islam**. Books and Allied (P) Ltd, Kolkatta. First edition.2011.
2. Cell Biology- **Powar.C.B**, Himalaya publishing house, New Delhi.1983.
3. Cell Biology - - **DeRoberties**, Blaze publishers & Distributors Pvt.Ltd., NewDelhi.
4. Fundamentals of Cytology – **Sharp**, Mc Graw Hill Company.
5. Cytology – **Wilson & Marrison**, reinform Publications.
6. Cell and Molecular biology concepts and experiments- **Gerald Karp**; 4 the Edition.

CORE COURSE II

GENETICS

UNIT I

Genome organization in Bacteria, Plant and Animal: Structure, types and forms & functions of DNA and RNA.

UNIT II

Mendelian laws of inheritance; Non-Mendelian inheritance; Chromosomal theory of inheritance. Back cross and Test cross.

UNIT III

Chromosome structure in Bacteria, Plants and Animals, Chromosome aberrations Structure. Mutations – Spontaneous and induced, chemical and Physical mutagens.

UNIT IV

Fundamentals of Microbial genetics – Conjugation, Transduction, Transformation. Analysis of mutations in biochemical pathways, one gene – one enzyme Hypothesis. One gene one polypeptide hypothesis.

UNIT V

Genetic diseases, Prenatal diagnosis: Genetic counseling: Population genetics. Genetic model organisms and their significance. (*E.coli*, *Arabidopsis thaliana*, *Coenorhabditis elegans*.)

REFERENCES:

1. Cell and Molecular Biology – **Robertis et al.** Waverly publication, edition 8, 1995.
2. Genetics – Strickberger, **M.W. Printice hall**, edition 4, 1997.
3. Molecular Biology of the Cell – **Alberts**. Garland publication, edition 4, 2002.
4. Text Book of Cell and Molecular Biology – **Ajay Paul**. Books and Allied (P) Ltd, edition 2, 2007.
5. Principles of Genetics – **E.J. Gardener, M.J. Simmons and D.P. Snustad**, John Wiley & Sons Publications.

SKILL BASED ELECTIVE COURSE I

TAXONOMY AND BIODIVERSITY

UNIT I

Classification - Artificial, natural and phylogenetic system of classification, Whittaker's Five kingdom system, Major characteristics features used in taxonomy - classical and molecular, taxonomic hierarchy, taxon, nomenclature and species concept. Numerical taxonomy

UNIT II

Classification of prokaryotes - Bacteria, Archaea and Actinomycetes. Characteristic features of the domain and phylum. General classification of viruses-morphological structure

UNIT III

Classification of eukaryotic microorganisms Fungi, Algae and Protozoa with their characteristic features.

UNIT IV

Principles of Plant taxonomy - Bentham and Hooker classification upto the level of order . Animal taxonomy - origin of vertebrates and invertebrates upto class level with one example.

UNIT V

Biodiversity -definition, global and Indian perspective, hot spots, IUCN, climate change.

REFERENCES:

1. Prescott, Harley and. Klein's Microbiology. 7th edition. **Wiley JM, Sherwood LM, and Woolverton CJ.** (2008). S. Chand and Company Limited, New. Delhi.
2. Principles of Microbiology. **Atlas M.R.** (1995)McGraw-Hill co Ltd.
3. Introduction to the principles of plant taxonomy. **Shivarajan,V.V.**1991.2nd edition.Cambridge University Press

4. Biology. **Campbell, N.A.** (2002). Sixth Edition. Menlo Park. California: Benjamin/Cummings Publishing Company. Inc.
5. Plant Taxonomy. **Sharma O.P.** (1993). Tata McGraw-Hill Publishing Company Limited, New Delhi.

CORE PRACTICAL 1

LAB IN CELL BIOLOGY & GENETICS

CELL BIOLOGY

1. Microscopes and its parts
2. Micrometry - Stage and Ocular Micrometer.
3. Cell Counting - Haemocytometer
4. Mounting buccal epithelium and observing living cells using vital staining.
5. Mitosis in Onion root tip squash
6. Meiosis in grasshopper testis squash
7. Chironomous - Salivary gland Chromosome squash preparation
8. Staining of macro molecules- Carbohydrates and Lipids..
9. Observation o slides (Cardiac muscle, Sperm cell, Muscle cell).
10. Staining of Mitochondria in Yeast using Janus green.
11. Microtomy (Demo)

GENETICS

1. Karyotype analysis: Man – Normal and Abnormal – Down and Turner’s Syndromes.
- 2 Mendel’s laws of genetics - . Mono and Dihybrid crosses.
3. Rearing morphology of drosophila (mutant eye identification)
4. Observation of Genetic model organisms (*Arabidopsis thaliana* and *Coenorabditis elegans*).

CORE COURSE III

FUNDAMENTALS OF MICROBIOLOGY

UNIT I

Definition and scope of Microbiology, History and recent developments, contribution of Leeuwenhoek, Louis Pasteur, Robert Koch, Elie Metchinkoff, Edward Jenner and Alexander Fleming. Media and its types.

UNIT II

Microscopy- Simple and compound microscopy, Dark field, Phase contrast, Fluorescence and Electron Microscopy. Stain and staining techniques- Simple, differential and special staining (Endospore, Capsular).

UNIT III

Cellular structures of prokaryotes and eukaryotes – Ultra structure and functions of prokaryotic cell wall, Plasma membrane, Flagella, Structure and functions of Cyanobacteria.

UNIT IV

Sterilization- Physical and chemical. Growth of bacteria – multiplication – nutritional requirements – factors affecting growth - growth curve – Determination of growth. Culture techniques – Pure culture, anaerobic culture- preservation of cultures.

UNIT V

Antimicrobial chemotherapy – Antibiotics – mode of actions – antimicrobial resistance - tests for sensitivity to antimicrobial agents.

REFERENCES:

1. A Text book of Microbiology. **Dubey, RC and Maheswari DK** (2005). S. Chand & Company Ltd., New Delhi.
2. College Microbiology. **Sundara Rajan S** (2003). Volume 1 7 2. Revised Edition, Vardhana Publications, Bangalore.

3. Microbiology- **Pelczar Tr. MJ, Chan ECS & Kreig NR** (2006). 5th Edition, Tata McGraw-Hill companies Ltd.
4. Microbiology - **Prescott LM, JP Harley and DA Klein** (2005). 6th international Edition, McGraw-Hill companies Ltd.
5. General Microbiology -**Robert F Boyd** (1984). Times Mirror / Mosby College publishers.

SKILL BASED ELECTIVE COURSE - II

DEVELOPMENTAL BIOLOGY

UNIT I

Spermatogenesis and Oogenesis in mammals, menstrual cycle, Monitoring of estrus cycle, Sperm banking.

UNIT II

Activation of sperm and egg– interaction of sperm and egg – Sequence of events in sperm entry – Egg surface changes. Post-fertilization changes:

UNIT III

Cell cleavage – pattern of cleavage – Chemical changes- Distribution of cytoplasmic substances in the egg –Metamorphosis (Insects and amphibians) - homeotic genes.

UNIT IV

Development of Microsporangium and Megasporgium, Pollination, Embryo, Seed. Out line of experimental embryology.

UNIT V

Organization of shoot and root apical meristem, and development. Phyllotaxy.

REFERENCES:

1. An Introduction to Embryology, **Balinsky, B.I.** (1981). *W. B. Saunders Co., Philadelphia*
- 2 Introduction to the embryology of Angiosperm, **Maheswari, P:** (1981) McGraw Hill..
- 3 Chordate embryology, **Verma , P.S., V.K. Agarwal and Tyagi,** 1995. S. Chand & Co., New Delhi.
4. Developmental biology **Gilbert, Scott's.** (1985). Sinauer Association, Inc., Publishers.
- 5 Development -**Berril, N.T., Karp, G. :** 1988. *Tata McGraw Hill Co., New York*
6. Patten's Foundation of Embryology, **Bruce M Carlson.** *Tata McGraw Hill Co.*

CORE COURSE IV

BIOPHYSICS AND INSTRUMENTATION

UNIT I

Nature of chemical bonds in Biological system. Spectroscopy- Beer-Lamberts law. UV-Visible Spectrophotometer (single and double beam), IR Spectroscopy, Atomic Absorption Spectroscopy and NMR.

UNIT II

Imaging methods- X-ray, CT scan, ECG, EEG. Centrifugation- Differential and density gradient. Methods for detecting radioactivity- GM and Scintillation counters.

UNIT III

Principle and applications of Chromatographic techniques- GLC, HPLC, Ion Exchange, Affinity Chromatography. Electrophoretic techniques- AGE, SDS-PAGE, 2-D Gel, X-ray crystallography.

UNIT IV

Care and maintenance of laboratory equipments- Microscope, Balance. pH meter, Distillation plant, Autoclave, Incubator, Automatic dispenser and dilutors.

UNIT V

Electrodes for bioelectric potentials- Micro, Skin surface and Needle electrodes. Biological containment systems- safety levels. Laboratory safety symbols. Potential hazards of laboratory techniques.

REFERENCES:

1. General Biophysics, vol. I & II – **H.V. Volkones**.
2. Bioseparations. **B.Sivasankar**. First edition. 2010. PHI Learning Pvt Ltd, New Delhi
3. Biophysical chemistry – **Upadhyay**, Himalaya Publication, edition 3, 2005.
4. Biophysics - **S. Mahesh** (2003), New Age International (P), Ltd.
5. Techniques and methods in Biology. **K.L Ghatak**. 2001. First edition. PHI Learning Private Limited, New Delhi.

CORE PRACTICAL - II

LAB IN MICROBIOLOGY & BIOPHYSICS

MICROBIOLOGY

1. Sterilization Techniques & sterilization of Media, Glass wares
2. Media Preparation (solid & liquid)
3. Isolation & Enumeration of Micro-organism from water and Soil.
4. Types of culture method-streak plate pour plate, Stab & slant preparation.
5. Measurement of Growth rate of bacteria- Turbidometric method
6. Staining Techniques – Grain's staining, Spore staining, Acid fast, Lacto phenol Cotton Blue staining.
7. Hanging drop technique.
8. Characterization of micro organisms – IMViC tests.
8. Microscopic slide preparation – Fungi & Bacteria.
9. Antibiotic sensitivity Test- Kirby Bauer method.

BIOPHYSICS

1. Determination of PH using PH meter.
2. Sedimentation of Emulsion of oil
3. Agarose Gel Electrophoresis & SDS-PAGE.
4. Isolation & Purification of protein (Dialysis)
5. Estimation of protein – Lowry's Method, Bradford Method.
6. Estimation of DNA by DPA method.
7. Estimation of RNA by Orcinol method.
8. ECG and EEG (Demo)

CORE COURSE V
MOLECULAR BIOLOGY

UNIT I

Central dogma of molecular Biology. DNA Replication. Prokaryotic and Eukaryotic DNA replication, Mechanism of DNA replication, Enzymes and accessory proteins involved in DNA replication. DNA Repair – light and dark mechanisms . Regulation of gene expression-lac and trp operons.

UNIT II

Transcription- Prokaryotic Transcription, Eukaryotic Transcription, RNA polymerase. Transcriptional and post-transcriptional gene silencing. Modifications in RNA. 5' cap formation, 3'-end processing and polyadenylation, splicing, Editing, Nuclear export of mRNA.

UNIT III

Translation-Prokaryotic and eukaryotic translation, the translation machinery, Mechanisms of initiation, elongation and termination, co- and post-translational modifications of proteins. Import into nucleus, mitochondria and chloroplast. Receptor mediated endocytosis.

UNIT IV

Oncogenes and Tumor Suppressor Genes-Viral and cellular oncogenes, tumor suppressor genes from humans, Structure ,function and mechanisms p53 tumor suppressor proteins. Homologous Recombination-Holliday junction.

UNIT V

Molecular Mapping of Genome-Genetic and physical maps. Southern and fluorescence in situ hybridization in genome analysis.

REFERENCES:

1. Molecular Biology, Labfax, **T.A.Brown**, Bioscientific publishers ltd, Oxford, 1991.
2. Molecular Biology of gene(4th Edition), **J.D.Watson, N.H.Hopkins, J.W.Roberts, J.A.Steitz and A.M.Weiner**. The Benjamin/Cummings

publications C Inc. California, 1987.

3. Molecular Cell Biology. 2nd Edition, **J. Darnell, H. Lodish and D. Baltimore**, Scientific American Book, USA, 1994.

4. Molecular Biology of the Cell (2nd Edition) **B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J. D. Watson**, Garland Publishing, Inc. New York, 1994.

5. Molecular Biology and Biotechnology. **K. G. Ramawat and Shaily Goel**. 2010. First edition. S. Chand Company, New Delhi.

CORE COURSE VI
PLANT BIOTECHNOLOGY

UNIT I

History of plant tissue culture - Laboratory organization - sterilization techniques – Media preparation –Types of media – MS media, Nitsh media, Gamborgs media – Plant growth regulators.

UNIT II

Plant micro propagation – micro grafting – advantages – virus elimination and shoot tip cultures. Role of tissue culture in agriculture, forestry. Edible vaccines from plants.

UNIT III

Protoplast isolation – fusion - Culture regeneration - somatic hybrids - cybrids. Establishment and maintenance of callus and suspension cultures. Somatic embryogenesis - Synthetic seeds.

UNIT IV

Haploid plant production, triploid production, Anther and microspore culture, embryo culture and embryo rescue. Invitro pollination and fertilization. Gene transfer techniques in plants. Transgenic plants. Terminator seed concept.

UNIT V

Somaclonal and Gametoclinal variation, Secondary metabolites, biotransformation and metabolic engineering, Plant genome project – Arabidopsis, Cryopreservation and germplasm conservation.

REFERENCES:

1. Introduction to Plant Biotechnology **Chawla**,(2003) (2nd edn) Oxford and IBH Publishers
2. Biotechnology applications of Plant Tissue & Cell culture.
Ravishankar G.A and VenkataramanL.V, 1997.Oxford&IBH Publishing co., Pvt Ltd.

3. Plant Biotechnology. **R. Keshava Chandran and K.V. Peter.** First edition. University Press (India) Pvt Ltd, Hyderabad.
4. A Text Book of Biotechnology. **R.C. Dubey.** S.Chand& Co Ltd, New Delhi.
5. Plant biotechnology by **Ramawath** ,2003, S. Chand and co, edition 2, 2003.
6. Plants, Genes and Agriculture, **Chrispeel M.J ,Sadava D.E,**1994, Jones and Barlett Publication, Boston.
7. Biotechnology, **Satyanarayana.** U, 2008, Books and Allied (p) Ltd.

CORE COURSE VII

RECOMBINANT DNA TECHNOLOGY

UNIT I

History and recent developments in rDNA Technology - Enzymes in rDNA Technology – Cutting enzymes, Joining enzyme and modifying enzymes. –Strategies in gene cloning- Restriction, Ligation.

UNIT II

Plasmids - Size - Copy Number - Amplification- Types of Plasmids- Bacterial cloning vectors- pBR322 - origin – advantage –pUC - Col E1 plasmid. Lamda phage vectors, cosmids and phagemid as vectors.

UNIT III

Animal and Plant Viruses and their use as vectors, Shuttle vectors, Expression vectors. Screening and selection of recombinants- Hybridization techniques.

UNIT IV

Gene transfer techniques. Molecular mechanism of antisense technology. PCR-types and applications, RAPD, RFLP, Micro arrays. DNA sequencing methods. Molecular diagnosis, Blotting techniques.

UNIT V

Construction of genomic and cDNA libraries, screening of libraries, Site directed mutagenesis, Chromosome jumping. Ethical issue involving in rDNA Technology. rDNA Technology in solving human problems. Safety regulations in rDNA techniques.

REFERENCES:

1. From Genes to Clones Introduction to Gene Technology - **Winnacker, E.L.** 1987., Panima Educational Book Agency, New Delhi.
2. Principles of Gene Manipulation and Genomics - **Primrose, S.B. and Twyman, R.M.** 2006. 7th Edition. Blackwell Publishing Company.
3. Recombinant DNA Second Edition - **James D. Watson, Micheal Gilman, Mark Zoller**, 2001. W.H. Freeman and Company, New York.
4. Biotechnology, **Satyanarayana. U**, (2008), Books and Allied (p) Ltd.
5. A Text Book of Biotechnology. **R.C. Dubey**. S.Chand& Co Ltd, New Delhi.

ELECTIVE COURSE I

IMMUNOLOGY AND IMMUNO TECHNOLOGY

UNIT I

Historical perspectives and overview of immune system, innate and acquired immunity. Haematopoiesis. Cells and organs of the immune system.

UNIT II

Antigen – Properties, Classes. Haptens, Mitogens, Adjuvants . Humoral response – B cell activation and proliferation. Cell mediated immunity – T cell receptors and its activation.

UNIT III

Immunoglobulins – Structure and function. Antigen – Antibody reactions – Agglutination, precipitation, RIA, ELISA, FACS and immunopanning. Hybridoma technology. Organization and expression of immunoglobulin genes. Chimeric antibodies.

UNIT IV

Cytokines: Types and function, Complement- Properties and activation pathways, Major Histocompatibility Complex. Transplantation immunology.

UNIT V

Hypersensitivity and its types. Autoimmunity, Cancer immunology, Vaccines. Care and maintenance of laboratory animals. Immunotherapeutics.

REFERENCES:

1. Immunology and Immunotechnology. **Rajasekara pandian M and Senthil kumar B** (2007), Panima publishing corporation , New Delhi.
- 2 Immunology by **J.Kubey** (1993) Freeman and company.
3. Immuno-biology by **Janeway CA and Paul Travers** 1994.
4. Text Book of Immunology by **Seemi Farhat Basir**. First edition. PHI Learning Pvt Ltd, New Delhi.

5. A Text Book of Immunology by **P. Madhavee Latha**. First Edition.
S.Chand & Company Ltd, New Delhi.

SKILL BASED ELECTIVE COURSE – III
BIOINFORMATICS, INTELLECTUAL PROPERTY RIGHTS AND
BIOSAFETY

UNIT I

Bioinformatics –definition, introduction, history and scope. Databanks – Gen Bank, PDB. Literature Databanks - Pubmed, Med line. Human Genome Project.

UNIT II

Biological databases including both proteins and nucleic acids – Sequence – EMBL, DDBJ. Structural databases - CATH, SCOP. Specialized database – Genome data base, EST.

UNIT III

Sequence Alignment based on Matrices (BLOSUM and PAM), Algorithm (Needleman Wunsch & Smith Waterman). Tools for sequence alignment – BLAST, FASTA.

UNIT IV

IPR & IPP – Patents, copy rights, trade secrets, trade marks. Plant breeders right patenting of biological materials. Patents of biotechnology in India. WIPO, GATT, and TRIP.

UNIT V

Biosafety – Risk for human health, environment and agriculture. Biosafety guidelines, regulation and operation.

REFERENCES:

1. Bioinformatics- Methods and applications. **S.C.Rastogi, N.Mendiratta and P.Rsatogi**. Third edition. PHI Learning Pvt Ltd, New Delhi.
2. Bioinformatics- A practical guide to the analysis of genes & protein 2nd **ED Andreas,Baxevanis and Francis Ouellette**.
3. Bioinformatics. **David H Mount**. 2005. Second Edn. CBS Publishers, New Delhi.

4. Biosafety board of trustees, **Trayror, P.C Frederic,R and Koch,M** 2002.Muchigan State university, USA.
5. Concepts, Theories and Practice of Human Rights, **Vadakar Praveen,** 2000.Rajat publications.
6. Biosafety and Bioethics, **Rajmohan joshi** 2006
7. Hand book of Indian Patent Law and Practice;1998. **Viswanathan,S** Published and printer, chepter, Chennai.

SKILL BASED ELECTIVE COURSE – IV

FOOD BIOTECHNOLOGY

UNIT I

Micro organisms associated with food - bacteria, fungi & yeast.
Enzymes in food preparation. Food contaminations. Food preservation & Food spoilage- types. Canned foods.

UNIT II

Food borne diseases. Food colors (natural & artificial food colourants) – carotenoids, anthocyanins and melanin. Food flavoring agents.

UNIT III

Food engineering operations: Characteristics of food raw materials, preparative operations in food industry, cleaning of food raw materials, sorting of foods, grading of foods.

UNIT IV

Food quality: Sensory evaluation of food quality, quality factors for consumer safety, food safety standards. FSSA, HACCP and FDA.
Processing plants- Cleaning and sanitation methods

UNIT V

General principle, plant design – design, construction, functionality of building, design & fabrication of equipment. Plant layout Pest proofing/ fumigation methods. Water supply to food processing unit.

REFERENCES:

1. Food Processing & Preservation – **B.Siva** PHI Learning Pvt Ltd 2011.
2. Fundamentals of Food Engineering – **D.G. Rao**, PHI Learning Pvt Ltd 2010.
3. Food Microbiology – Fundamentals & Frontiers – **Michael P. Doyle, Larry. R.**
4. Food Microbiology – **Frazier**. McGraw Hill Publications. Fourth edition.
5. Food Biotechnology – **Yiu Hui & G. Khachatourians**.
6. Fundamentals of Food Microbiology - **Bibek, Laramie & Bhunia**, CRC Press.

CORE COURSE VIII

INDUSTRIAL BIOTECHNOLOGY

UNIT I

Historical developments in Fermentation. Outline of upstream processing. Screening of industrially important microbes. Strain improvement. Inoculum development.

UNIT II

Media formulation, Sterilization, Batch and continuous culture systems, Types of fermentation, Stoichiometry of cell growth and kinetics. Method of immobilization.

UNIT III

Bioreactor- Design, parts and their function. Types of bioreactors- CSTR, Air lift, Bubble column, Packed bed, Tower. Monitoring and control of process variables (Temperature, pH and DO).

UNIT IV

Production of microbial products: Enzymes- Amylase, Organic acid- Citric acid, Amino acid- Glutamic acid, Antibiotics- Penicillin, Solvent- Ethanol, Vitamins- Riboflavin and SCP.

UNIT V

Biofertilizers, Biopesticides, Mushroom technology, Vermitechnology, Biofuel technology, Biodyes.

REFERENCES:

1. Fermentation Microbiology and Biotechnology. **El – mans, E.M.T., and Bryce, C.F.A.** 2002. Taylor & Francis group.
2. Industrial Microbiology – **A.H. Patel**, MacMillan Publishers , 2005.
3. Principles of Fermentation Technology. **Stanbury P.F. and Whitaker, A.**1984. Pergamon Press.
4. Comprehensive Biotechnology – Volume 2,3, and 4. **Moo – young, M.** (ed).1985. Pergamon Press.
5. Biotechnology, **Satyanarayana. U,** (2008), Books and Allied (p) Ltd
6. Experimental Procedures in Bioprocess technology and Down stream processing. **P.Ponmurugan, Nithya Ramasubramanian and Fredimoses.** 2012. Anjana Book House, Chennai.

CORE COURSE IX
ANIMAL BIOTECHNOLOGY

Unit I

Historical Perspectives, early experiments & Scope of Animal tissue culture. Requirements for Animal cell culture. Media-Natural, Semi synthetic & Synthetic. Metabolic profiling of Animal cell culture. Design & layout of ATC laboratory.

Unit II

Basic Techniques of mammalian cell culture; Disaggregation of animal tissue. Primary culture, Evolution of cell line, Monolayer, suspension culture, Polymeric matrix construction Organ culture, Embryo culture. Maintenance of cell culture.

Unit III

Sericulture, Commercial production of silk, Baculoviruses as animal viral vector. Silkworm as a bioreactor. Biotechnology of aquaculture, apiculture.

Unit IV

Embryo Technology & Animal Breeding. In vitro fertilization, Embryo transfer, ICSI, Embryo splitting, Fertility control & regulation, test tube babies. Cell cloning methods. Transgenic animals-Sheep, Mice.

Unit V

Stem cells- types, culture and applications. Gene therapy. Cell culture based vaccines. Ethical values in animal biotechnology.

REFERENCES:

1. Animal Tissue culture- **Sudha Gangal**. Second edition. University Press (India) Pvt Ltd. Hyderabad.
2. Animal Biotechnology – **M. Ranga**. Studam publishers, 2006.
3. Animal Biotechnology-**R.Sasidhara**, MJP Publishers, 2006.
4. Biotechnology- **Satyanarayana**. U, (2008), Books and Allied (p) Ltd

5. A Text Book of Biotechnology. **R.C. Dubey**. S.Chand& Co Ltd, New Delhi.

ELECTIVE COURSE II

ENVIRONMENTAL BIOTECHNOLOGY

UNIT I

Marine micro flora - phytoplankton, seaweed, sea grasses & mangroves. Marine invertebrates - crustaceans, mollusks) & vertebrates. Marine natural products – carrageenan, agar, agarose, sea weed fertilizers, bioactive compounds. Marine pharmacology – Marine toxins, antiviral & anti microbial agents.

UNIT II

Marine fouling – macro fouler, anti fouling methods. Aqua culture. Aqua farms – design & construction. Culture systems – extensive, semi intensive & raceway cultures.

UNIT III

Biochemical & Genetic basis of Bioremediation - Bioremediation of soil, water, contaminated with oil spills, heavy metals & detergents. Phytoremediation, Degradation of pesticides & petroleum products.

UNIT IV

Biofilms, Bioenergy and Biofuels, Biosensors in environmental monitoring, Environmental significance of GMO's. Eco management.

UNIT V

Noise, Air, Water & Gaseous pollution. Waste management – nuclear, solid & liquid- Primary, secondary and tertiary treatment methods. Bioleaching. Environment protection Act & Policies.

REFERENCES:

1. Environmental biotechnology - **Alan Scragg**, Pearson Education Limited.

2. Environmental Biotechnology. **A.K.Chatterji**. Third edition. PHI Laerning Pvt Ltd. New Delhi.
3. Principle of Environmental Science – **William p. Conningham & Mary Ann**, Tata Mc Graw Hill Publishing Co.
4. Biodiversity & Environment – **Agarwal** et al.
5. Marine Biology: Function, Biodiversity & Ecology – **Jeffery S. Levinton**.
6. Recent Advancement in Marine Biotechnology – **Fingerman M**, Science Publishers 2000.
7. Encyclopedia of Aqua culture – John Wiley Sons Inc 1063.
8. Oceans & their Physics, Chemistry & Biology – **Sverdrup H.V. Johns & R.H. Fleming**, Prentice Hall Inc.

ELECTIVE COURSE III

PLANT MOLECULAR BIOLOGY

UNIT I

Genome organization. Nucleus, plastid and mitochondrial genome organization. Transposons in plants, transposable elements and transgenesis.

UNIT II

Regulation of gene expression in plants – Nuclear genes, Organellar genes(plastid and mitochondrial genes), Signaling mechanism in gene regulation.

UNIT III

Molecular biology of N₂ fixation, nif gene rearrangement and N₂ fixation in cyanophytes, nif gene transfer in Chloroplast. Agrobacterium and crown gall tumor formation.

UNIT IV

Plant gene expression cassettes – selectable markers, reporter genes and promoters in plant vectors. Direct transformation of plant – physical methods.

UNIT V

Molecular marker techniques - RFLP, RAPD, AFLP and QTL. Virus resistance, delayed fruit ripening, production of Plantibodies , Cytoplasmic male sterility.

REFERENCES:

1. Plant biochemistry and Molecular biology, **Lea, P.J & Leegood**; 1993 John Wiley & sons.
2. Plant virology. **Mathew, R.E, 1991**, Edition 3, Academic press.
3. Molecular genetics of Photosynthesis, **Anderson, B Salter, H**, 1996., IRL press, Oxford.
4. A Text Book of Biotechnology. **R.C. Dubey**. S.Chand & Co Ltd, New Delhi.
5. Biotechnology, **Satyanarayana**. U, 2008, Books and Allied (p) Ltd.

SKILL BASED ELECTIVE COURSE V

PHARMACEUTICAL BIOTECHNOLOGY

UNIT I

History & Principle of pharmacology. Drug names & Classification systems. General Principles of Drug action Pharmacokinetics, Pharmacodynamics, measurement of drug action.

UNIT II

Chemotherapeutic drugs- Protein synthesis inhibitors, Antimycobacterial, antifungal, antiprotozoal, antiviral, Anthelmintic, anticancer, anti-inflammatory drugs.

UNIT III

Techniques of r-DNA technology for production of Biologicals: Human Insulin, HGH, GRF, Erythropoietins, IFN, TNF, Interleukins, Clotting factor VIII.

UNIT IV

Production of Ergot alkaloids, Probiotics, Production of recombinant vaccines. Anticancer agents and anti-inflammatory agents in chemotherapy.

UNIT V

Biochips, Biofilms, Biosurfactants, Biorepellents. Protein Engineering, Tissue Engineering.

REFERENCES:

1. Pharmaceutical Biotechnology – **S.S. Purohit, Kaknani, Saleja**
2. Pharmacology – **Mary J. Myuk, Richard A. Hoarey, Pamala** Lippinwitt Williams edition.

3. Pharmacology – **H.P. Rang, M.M. Pale, J.M. Moore**, Churchill Livingston.
4. Integrated pharmacology – **Page, Curtis, Sulter, Walker, Halfman**. Mosby Publishing co.
5. A concise Text Book of Pharmacology. **N.Muruges**. Sixth edition. Sathya Publishers, Madurai.
6. A Text Book of Biotechnology. **R.C. Dubey**. S.Chand& Co Ltd, New Delhi.

SKILL BASED ELECTIVE COURSE VI

NANO BIOTECHNOLOGY

UNIT I

Nanobiology-concepts, definitions, prospects. Biological Nano objects –DNA, protein, lipids. Biological networks. Bionanoparticles- Nanostarch, Nano composites- Dendrimers.Hot-Dot nano particles.

UNIT II

Methods of Nanobiotechnology - Analysis of bimolecular Nanostructures by Atomic Force Microscopy, Scanning Probe Electron Microscopy. Nanofabrication- Lithography.

UNIT III

Biosensors – Types: Potential, Electrochemical & Biomembrane based sensors. Imaging techniques-digital & molecular.

UNIT IV

Drug delivery systems –polymer therapeutics - polymer drug conjugates; Liposome. Determination of mechanical properties - Mechanical testing, Elasticity, Toughness.

UNIT V

Application of Nanobiotechnology in medicine, Drug designing and Cancer treatment. Medical, Social and Ethical considerations of Nanobiotechnology.

REFERENCES:

1. Biomaterials Sciences: An Introduction to Materials in Medicine 2nd Edition,

Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen and Jack E.

Lemons.

2. Lehninger's Principles of Biochemistry, 4th Edition, **David L. Nelson and Michael M. Cox**, 2006

3. Nanobiotechnology: Concepts, applications and perspectives, **Christof M. Niemayer, Chad A. Mirkin**, Wiley VCH publishers 2004.

4. Bionanotechnology: Lessons from Nature, **David. S. Goodsell**.
Jhonwiley 2006.

5. Naobiotechnology: Molecular Diagnosis, **K.K. Jain, Tailor L.** Francis
Group.

CORE PRACTICAL III

LAB IN IMMUNOLOGY, DNA TECHNOLOGY AND BIOINFORMATICS

1. Agglutination tests:

ABO blood grouping,

WIDAL test,

Latex Agglutination

ASO test,

Pregnancy test.

Haem agglutination test

2. Precipitation:

Radial Immunodiffusion,

Double Immunodiffusion,

Immuno electrophoresis,

Counter Current Immuno electrophoresis.

3. ELISA

4. Isolation and visualization of plasmid DNA.

5. Restriction Digestion of Lamda DNA.

6. Ligation of DNA Fragments.

7. Isolation of Antibiotic Resistant Mutants- Gradient plate method.

8. Bacterial Transformation.

9. Bacterial conjugation.

10. Sequence retrieval from any Databank.

11. Sequence alignment by BLAST.

12. Protein visualization tool- Rasmol.

CORE PRACTICAL IV

LAB IN INDUSTRIAL, PLANT AND ANIMAL BIOTECHNOLOGY

1. Isolation of any one industrially important enzyme and antibiotics
2. Production and estimation of biomass (SCP) – dry weight and wet weight method.
3. Production of wine
4. Immobilization of yeast cells
5. Immobilized beads for alcohol production and estimation.
6. Mushroom cultivation
7. Plant Tissue culture media preparation
 - MS Media
 - Nitsch's media
 - White's media
8. Callus induction
9. Micro propagation
10. Protoplast isolation
11. Green house visit
12. Preparation of Animal cell culture media, Single cell suspension, Viability test and Cell counting
13. Culture of chick embryo fibroblast
14. Inoculation virus and observation

NON MAJOR ELECTIVE COURSE I

CONCEPTS OF BIOTECHNOLOGY

UNIT I

Scope of Biotechnology. History of Biotechnology: Conventional and Modern Biotechnology – Biotech industries. Biotechnology Tree. Strategies of gene cloning.

UNIT II

Tools used in gene cloning – Restriction endonucleases – Types – Features. Ligases – Linkers, adaptors and homopolymer tails. Modifying enzymes.

UNIT III

Vectors – Properties of good Vector .Constructed plasmids- pBR322. Cosmid vectors, Animal vectors- SV40. Plant vectors- Ti derivatives.

UNIT IV

Introduction of genes – Vector mode – transformation and transfection. Vector less mode –Biolistics, Electroporation, Microinjection.

UNIT V

Selection of recombinants. Marker techniques- PCR, RFLP, RAPD and blotting techniques

REFERENCES:

1. Principles of Gene Manipulation **Old & Primrose**, (1989), 3rd edition
2. Biotechnology, **Satyanarayana**. U, (2008), Books and Allied (p) Ltd
3. Biotechnology and Genomics, **Gupta P.K**: (2004) Rastogi publication.
4. Gene cloning and DNA analysis **Brown, T.A** (1996),. Blackwell science, Osney Mead, Oxford.
5. A text book of Biotechnology, **Dubey, R. C.** (2007), S.Chand & Company Ltd. New Delhi.
6. Biotechnology, **Singh, B. D** (2004). Kalyani Publishers, New Delhi

Note: This paper is offered for other major students.

This paper has to be taught and exam Paper to be valued by only
Biotechnology Board

NON MAJOR ELECTIVE- II
BIOTECHNOLOGY FOR SOCIETY

UNIT I:

Sericulture. Aquaculture, Apiculture. Vermiculture. Mushroom technology.

UNIT II:

Biofertilizers. Biopesticides. Biorepellants. Pest control and management. Biomass (SCP). Bioplastics. Bioweapons.

UNIT III:

Bio dyes,. Bio fuels – Biodiesel & Biogas. Bioindicators. Biodegradation- Role of GMO's.

UNIT IV:

Production of Penicillin, Recombinant Vaccines (HBV). Recombinant Insulin. Plantibodies. Vaccines in animal cells, Gene therapy.

UNIT V:

Transgenic animals and their applications- Mice, Sheep and Fish. Transgenic plants and their applications- BT Cotton, Flavr-Savr tomato and Golden rice.

REFERENCES:

1. Animal Biotechnology ,**M .M. Ranga**, (2000) , Agrobios (India),
2. Introduction to Plant Biotechnology **Chawla**,(2003) (2nd edn) Oxford and IBH publishers
3. Biotechnology,**Satyanarayana**. U, (2008), Books and Allied (p) Ltd.
4. Industrial Microbiology – **A.H. Patel**, MacMillan Publishers, 2005
5. A text book of Biotechnology, **R. C. Dubey**, (2001), Rajendra Printer. New Delhi.
6. Environmental Biotechnology. **A.K.Chatterji**. Third edition. PHI Learning Pvt Ltd. New Delhi.

Note : This paper is offered for other major students.

This paper has to be taught and exam Paper to be valued by only Biotechnology Board.